CENTER FOR BEAM PHYSICS SEMINAR

"Vacuum Laser Acceleration"

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••• Refreshments served at 10:20 AM •••

Abstract: It has been found that for a focused laser beam propagating in free-space, there exists, surrounding the laser beam axis, a subluminous wave phase velocity region. Relativistic electrons injected into this region can be trapped in the acceleration phase and remain in phase with the laser field for sufficiently long times, thereby receiving considerable energy from the field. Optics placed near the laser focus are not necessary, thus allowing high intensities and large energy gains. We call this acceleration scheme the CAS (capture and acceleration scenario). Important features of CAS are examined via test particle simulations. The basic conditions for CAS to occur have been found as follows. (i) The laser intensity should be very strong ($a_0 \geq 5$). (ii) The electron injection energy should be in the range 5-15 MeV. (iii) The electron incident crossing angle (relative to the beam direction) should be small (typically $\tan\theta \approx 0.12$). The resulting energy gains (e.g. 114MeV (490MeV) for laser intensity $a_0=10$ (30)) are in agreement with theoretical estimates based on acceleration by the axial laser field. The output beam properties of the CAS scheme are studied in quantitative detail, such as the energy spectra, angular distributions, energy-angular correlations, the fractions of the CAS electrons in the input electrons, as well as the emittances of the outgoing electrons. The results show that it is hopeful that CAS becomes a useful scheme for laser accelerators, and it is worthwhile to experimentally test this scheme presently.

Biographical Sketch: Professor Ho obtained his Ph. D. in theoretical nuclear physics from Tsinghua University, Beijing, in 1965, where he is now a Concurrent Professor. He is Council Member of the Nuclear Physics Society of China, and of the National Key Basic Research Special Foundation. During his professional career he has visited many institutions outside China, and has published more than 140 papers. He won the Einstein Award at the Lasers 2000 Conference, December 2000 (Albuquerque). His current interests include intense laser interactions with matter, ion-beam and cluster-beam interactions with solid surfaces, and free-electron lasers.